River Herring Technical Expert Working Group (TEWG)

Climate Change Subgroup Webinar/Conference Call
July 21, 2014
12:00-2:00pm

Summary

I. Overview

The Climate Change Subgroup of the River Herring Technical Expert Working Group was established to "consider the impacts of climate change and climate variability on river herring rangewide (including freshwater)" in order to help contribute to the expected products of the TEWG. Janet Nye and Mike Alexander, co-chairs of the Climate Change Subgroup, convened a call on July 21, 2014, to hear and discuss the latest research on the impacts of physical factors on river herring derived from observations. The draft agenda for the meeting included topics such as: 1) speaker presentations; 2) discussion of presentations, and 3) river herring research needs. This meeting summary includes the primary discussion topics and outcomes to contribute to future TEWG discussions. The information provided below reflects individual expert opinion and not consensus.

II. Key Topics

The following is a list of individual expert opinions provided by Climate Change Subgroup members or the public on various overarching topics. Some ideas have been combined where appropriate.

- Speaker's conclusions (full presentations available at the website below under "Meeting Materials," which includes a complete list of authors) and individual comments include:
    - *Physiological and performance consequences of land-locking in alewifes,* presented by Jonathan Velotta (University of Connecticut). If outlet streams dry, the likelihood of landlocked alewives increases as young of year anadromous alewife are trapped in natal freshwater ponds. Landlocked alewives experience a reduction of anadromous capacities and traits (e.g., tolerance of saltwater is reduced for landlocked alewives, growth of landlocked alewives is stunted in seawater, feeding in seawater is reduced among landlocked alewives) which could contribute to declines. Anadramous alewife are in general better swimmers than landlocked alewives across all tested salinities.
        - Comments: There were differences between alewife's tolerance to salinity in different lakes, which may be due to how they had been landlocked (the longer the less their salinity tolerance). However,

difference may also be due to small sample size. Temperature was kept constant in this study (15-16^{o}C), but a suggestion was made to investigate how temperature and salinity also affects capabilities. Additionally, using scale samples to confirm that juvenile landlocked fish used in the experiments were indeed YOY fish could be considered. River herring may be more tolerant to environmental change based on its occurrence in two habitats and other reasons; however, they may be at their most vulnerable when transitioning between the two environments.

- *Stock-recruitment relationships of river herring in relationship to the freshwater phase*, presented by Desiree Tommasi (NOAA). Freshwater survival is influenced both by density dependent processes and environmental variation (e.g., flow, temperature). There are system specific differences in environment-survival relationship. In most systems, the period of larval growth in nursery habitats is critical to freshwater survival. The optimal temperature range is 18-22 degrees Celsius.
    - Comments: There was a question as to why the Ricker model was used for the population model rather than the Beverton Holt. The Ricker model was used as it gave slightly better fits overall according to the Akaike information criterion (AIC), but qualitatively the results were the same regardless of what equation you used. The decrease in alewife population occurred well below their thermal tolerance indicating that other factors, such as temperatures impact on predators could be at play. The stock structure from Palkovacs et al. (2013) could be considered for a future analysis to look at latitudinal differences. It was clarified that air temperature was used as a proxy for some river temperatures where data was not available.
- *An exploratory analysis of biotic and abiotic factors affecting mortality and recruitment of Monument River alewife*, presented by Gary Nelson (Massachusetts Division of Marine Fisheries). Seven covariates (striped bass [mortality equation], bluefish [recruitment equation], gray seal [mortality equation], Southern New England euphausiids [mortality equation], Gulf of Maine amphipods [mortality equation], September rainfall [recruitment equation], and December rainfall [recruitment equation]) significantly improved model fits to the alewife data, however, covariate significance and "best" multi-covariate model are not always consistent across models and peels (year of data and data weighting important). Three covariates (September rainfall recruitment, Gulf of Maine amphipods recruitment and striped bass mortality) appeared important since they were significant most frequently as single covariates and occurred most frequently in "best" multi-covariate formulations. One-year-ahead predictions of total run size were

very poor because only small amounts of total variation were accounted for by inclusion of covariates.

- Comments: What is the mechanism explaining why September rainfall was the variable most frequently included in the multifactor models? Peak emigration has been reported after heavy rainfall. Therefore, after heavy rainfall in the Monument River, fish ladders and river herring exit could be impacted. Higher recruitment of striped bass has been observed in years of high rainfall; switch in predatory forces could occur in the future.

- *Projected ocean warming creates a conservation challenge for river herring populations,* presented by Janet Nye (Stonybrook University). The study predicted declines in habitat (occurrence) and abundance under nearly all scenarios by 2060-2100 except for increases in abundance of both species in spring. Declines in the fall are predicted to be much greater than spring likely because fall is the warmest time of the year. Larger declines were predicted when population size was assumed to be low, and a decline in mean size of fish in the survey was seen. Thermal tolerances were calculated in the marine environment with quotient analysis
  - Comments: It would also be good to consider age class (size distribution) in future models. This study considered NMFS trawl surveys which reflects more offshore waters and large fish/adults, however, future analysis could consider nearshore waters from state trawl surveys and smaller fish/younger fish.
- *Atlantic Salmon information for the River Herring Technical Expert Working Group (TEWG),* presented by Kevin Friedland (NOAA Fisheries Northeast Fisheries Science Center). Recent trends and the 2012 warming event is consistent with predator driven mortality mechanism affecting Gulf of Maine salmon survival. Absence of complete loss of 2012 smolt class suggests the variation in predation pressure is not controlled by annual migrations of predators only, instead it reflects a shift in suitable habitat for predators. River herring migrate to sea during different time frames than salmon, but they would be affected by same the changes in resident predator fields. Pelagic predators are likely to take salmon post-smolt and would also likely take juvenile herring. However, it is not known whether similar results would be obtained for river herring given latitudinal patterns.
  - Comments: Other climate change signals may be responsible for salmon recruitment, in addition to the Atlantic Multi-decadal Oscillation (AMO).

- Dissolved oxygen and acidification should be added to this subgroup's list of climate stressors. For example, hypoxia is of a concern in some areas (e.g., Chesapeake Bay).

This is related to climate if precipitation and nutrient runoff increases with climate change.

III. Key Outcomes

Below is a list of individual expert opinions provided by participants related to specific threats, data gaps, research projects, information to be considered and/or monitoring (i.e., the identified research projects and/or conservation actions). Some ideas have been combined where appropriate. These outcomes are listed in no particular order, and those related to other subgroups are also included in the "Cross-Cutting Issues" section below).

a. Data Gaps
   - Collection of long-term environmental information is important (e.g., temperature for rivers).
   - More detailed studies on different life stages.

b. Research Projects
   - Refine understanding of the mechanisms that underlie the emergent environmental dependencies on freshwater survival.
   - Field/laboratory studies focused on river herring tolerance to low/high temperature and on the thermal sensitivity of prey-predator interactions.
   - Physiological (e.g., thermal) tolerances by life stage to understand sub-lethal impacts.
   - Consider ideas in the "Comments" sections listed above after the various presentations.

c. Information To Be Considered (e.g., published papers)
   - Karen Wilson's compilation of temperature tolerances of river herring.
     - Table and additional information found in the NMFS River Herring Climate Change Workshop report; http://www.nero.noaa.gov/prot_res/CandidateSpeciesProgram/sswpdocs/RIVER%20HERRING%20CLIMATE%20CHANGE%20WORKSHOP%20REPORT_122712.pdf
     - Full presentation found at: http://www.nero.noaa.gov/prot_res/CandidateSpeciesProgram/ClimateChangeWorkshop/Day%201/RH%20CC%20Workshop%20KWilson.pdf

IV. Next Steps

The Climate Change Subgroup discussed the following next steps:

- The next subgroup meeting will occur on August 14th from 12-2pm, and additional speakers will present.
- Janet will distribute Karen Wilson's compilation of temperature tolerances of river herring (see above).

- The subgroup should consider the list of climate-related data gaps that the group compiled during the last meeting to see if anything is missing.
- Although not discussed, a draft meeting summary will be distributed to the subgroup.

V. Cross-Cutting Subgroup Issues

The following cross-cutting subgroups issues were discussed and will be further considered by the TEWG and its Ecosystem Integration Committee.

- Difference tolerances of predators to environmental change could change impacts to river herring (i.e., switch in predatory forces could occur in the future).

VI. Participants

a. Subgroup Members

The affiliation of each member can be found on the subgroup roster available at the TEWG Climate Change Subgroup website:
http://www.nero.noaa.gov/protected/riverherring/tewg/climate/index.html

Peter Moore
Desiree Tommasi
Stephen McCormick
Karen Limburg
Peter Moore
Frank Borsuk
Janet Nye
Michael Alexander
Roger Rulifson
Karen Wilson
Jon Hare
Diane Borggaard

b. Public

Jonathan Velotta
Kevin Friedland
Gary Nelson
Tara Trinko-Lake
Joel Llopiz
Andrew Jones

VII. Meeting Materials

The following materials were provided to support the meeting. Additional information can be found at the TEWG Climate Change Subgroup website:
http://www.nero.noaa.gov/protected/riverherring/tewg/climate/index.html

a. Draft Agenda